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EXPLORATION GUIDELINES FOR VMS DEPOSITS

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Volcanogenic massive sulfide deposits (VMS) are stratiform or stratabound accumulations of base metal sulfides that formed in submarine settings on or immediately below the seafloor by precipitation from 250–350°C, dominantly seawater-derived hydrothermal liquids. Based on the study of VMS deposits hosted in ancient volcanic successions and their modern seafloor analogues, processes involved in the formation of these deposits are well understood. It has been shown that VMS deposits form mostly in zones of rapid, but short-lived extension within intraoceanic, transitional, and continental margin arcs. Many of the large VMS camps worldwide are hosted by bimodal volcanic successions. Extension results in crustal thinning and mantle depressurization, with mantle-derived mafic magmas being injected in the thinned crust. Ponding of mafic magmas causes partial melting of the crust, generating felsic melts. In many VMS camps, evidence for synchronous mafic and felsic volcanism is recorded by compositional shifts within the stratigraphic interval hosting the deposits and the occurrence of magma mingling and mixing textures in shallow intrusions and lavas. In many cases, VMS deposits occur in clusters along discrete stratigraphic intervals. While hydrothermal fluid flow is a universal process of heat transfer within the crust, the presence of such favorable stratigraphic intervals suggests that deposit formation is tied to particular processes in the regional tectonic and basin evolution. At the local scale, VMS deposits typically occur at topographic highs, marking the location of volcanic vents. Careful volcanic facies analysis has shown that VMS deposits always occur within vent-proximal volcanic facies associations. In many cases, a particular style of felsic volcanic centers is recognized as being particularly favorable. The location of volcanic centers hosting VMS deposits is controlled by syn-volcanic faults, which also form conduits for the hydrothermal fluid flow. Hydrothermal alteration halos associated with these structures represent important vectors to ore. In volcanic successions dominated by volcaniclastic rocks, massive sulfides are commonly formed by subseafloor replacement, while mound-style deposits formed on the ancient seafloor are more common in flow-dominated volcanic successions. In combination with geophysical and geochemical methods, these key elements of the VMS model can be used to guide exploration for massive sulfides in ancient volcanic successions.